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Felsic dust and Basaltic soils- Using Elemental Tracers to Determine the Dust Contribution to Soils.

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Aeolian dust is widely recognized as an important soil parent material and nutrient source. While in some regions soils develop primarily from wind-blown sediments, in many other settings, dust mixes into soils that form predominantly from in situ bedrock weathering. In such cases, identifying and quantifying dust contributions depends on clear mineralogical, chemical, or isotopic differences between the local bedrock and the allochthonous aeolian input.

In this study, we investigate the long-term contribution and geochemical signature of dust in the volcanic soils of the Golan Heights (northern Israel), located at the northwestern margin of the Haraat-a-Sham volcanic field. Frequent dust storms and the strong compositional difference between local mafic basalt and regional felsic dust provide and ideal setting for tracing aeolian inputs to the soils.

Soils were sampled along a south–north precipitation gradient (~450–1100 mm yr^{-1}), including both deeply developed profiles and shallow lithosols. Particle size distribution analyses reveal five distinct grain-size populations: coarse fractions (~400 and 90 µm), coarse and fine silt (~20–30 and 3–5 µm), and clay (~1 µm). The silt fractions are enriched in quartz and likely dominated by aeolian material; the fine silt population is consistent with regional Saharan dust, whereas abundant coarse silt quartz suggests an additional, more proximal source, likely east of the plateau. Mineralogical and geochemical dust tracers are most consistently expressed in the silt-size fractions, particularly fine silt.

Despite the abundance of quartz, bulk geochemical signatures do not uniformly reflect a strong felsic component. Elemental concentrations and ratios, including soluble elements and Rare Earth Elements, show variable mixtures of basaltic and dust-derived signals across bulk samples and size fractions indicating differential residence times of dust constituents along the climatic gradient. In deeper profiles, dust signatures are strongest near the surface and decrease with depth, indicating limited vertical mixing.

These results underscore the complexity of quantifying aeolian contributions in basaltic soils and highlight the need for integrating grain-size characterization with mineralogical and geochemical tracers when evaluating dust inputs.